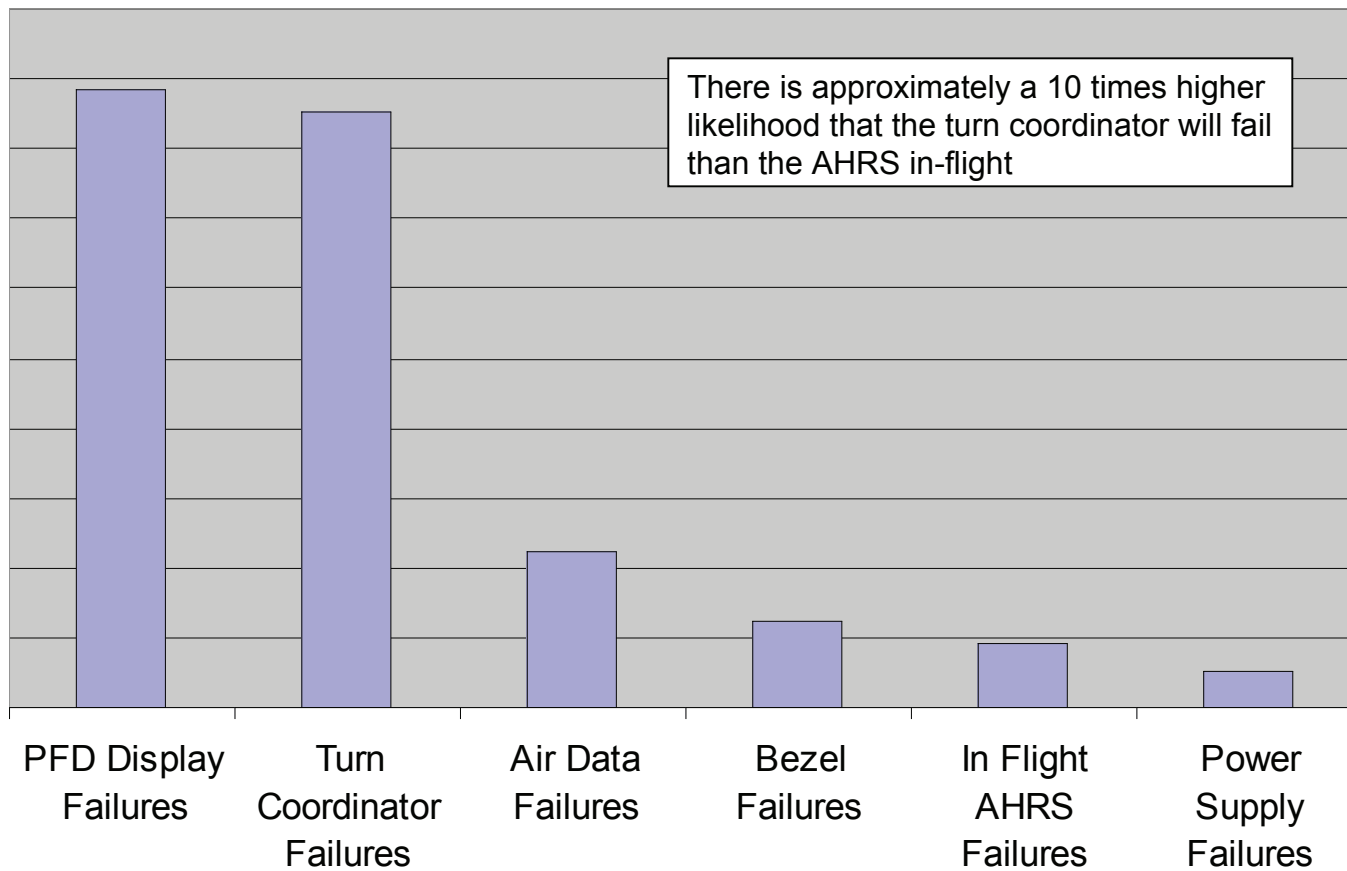


Failure modes and their impact on DFC90


- The only failure modes that result in loss of DFC90 are:
 - AHRS is unavailable (Red-Xs over attitude display)
 - PFD has no power whatsoever.
- Loss of the display (most common failure mode) or air data or almost any other failure mode does NOT render the DFC90 inop.

2009 Proportional Failure Rates for PFD

Proportional Failure Rates in PFD System - 2009 Data



Turn Coordinator reliability data supplied by the manufacturer



The next series of slides step through each column/category of the previous pareto chart. They will walk you through how you recognize the symptoms, what you've lost, recommended pilot actions and what functionality remains.

PFD Display Failure

(display unreadable but bezel button lights still lit)

EX5000 PFD – STec 55X

- **What lost?**
 - Ability to enter any autopilot commands
- **Recommended Pilot Actions:**
 - Consider pulling both PFD circuit breakers
 - This is difficult but allows the GPSS relay to be thrown, allowing the Garmins to drive AP in GPSS and VS to be controlled on ACP
 - Lose Heading hold capability if you do this
- **What you're left with:**
 - If CBs pulled, only have GPSS, ALT and VS via AP control head
 - If CBs not pulled, rely on the button timeout along right side of bezel, press the right knob to sync heading and use HDG mode. Still have Alt hold and GPSS functionality from Garmin 1

EX5000 PFD – DFC 90

- **What lost?**
 - Ability to enter some autopilot commands
- **Recommended Pilot Actions:**
 - Leave the PFD CBs alone
 - This is much safer and doesn't require cockpit gymnastics
 - Use AP sync capability and “count clicks”
 - *Alt Capture example:* press ALT for alt hold, push to sync either the VS or IAS knobs on ACP and twist in desired direction counting clicks (e.g. 5 CCW clicks of IAS results in 5 knots less than current IAS), engage IAS or VS to climb/descend and then press ALT again when standby shows desired altitude
- **What you're left with:**
 - Still have a very functional autopilot but with a degraded means of setting targets

Turn Coordinator Failure (AP FAIL in 55X system, Alert message in DFC90 system)

EX5000 PFD – STec 55X

- **What lost?**
 - Autopilot completely INOP
- **Recommended Pilot Actions:**
 - Seek VMC as soon as feasible but in all cases, apply extra attention since no autoflight capability
- **What you're left with:**
 - Hand-flying operations only (no autopilot functionality remains)

EX5000 PFD – DFC 90

- **What lost?**
 - Lost attitude comparators only
- **Recommended Pilot Actions:**
 - Re-engage AP in desired modes
 - DFC 90 will kick off during an attitude miscompare situation but allow manual re-engagement
 - Apply extra attention to your normal instrument cross-check
- **What you're left with:**
 - A fully functional autopilot, just without automatic attitude comparators running in background

Air Data Failure (Airspeed, Altitude and VS tapes are replaced with Red-Xs)

EX5000 PFD – STec 55X

- **What lost?**
 - Alt Capture capability
- **Recommended Pilot Actions:**
 - Do not pull PFD CBs – that is a very drastic move
 - Use a combination of ALT Hold and VS Mode to achieve new altitude using autoflight
 - This requires more attention during level off
- **What you're left with:**
 - All AP modes except true Alt Capture

EX5000 PFD – DFC 90

- **What lost?**
 - Alt hold, Alt Capture, IAS mode, VS mode, Envelope Protection
- **Recommended Pilot Actions:**
 - Press Straight and Level OR manually disconnect autopilot, maneuver airplane to desired attitude and re-engage via AP button which puts system into Roll and Pitch hold
- **What you're left with:**
 - All lateral modes including Heading
 - Roll and Pitch modes
 - Straight and Level
 - ILS including Glide Slope
 - “Pseudo VS”
 - Still can use VS knob on ACP but it's actually controlling pitch – considered equivalent to VS

PFD Bezel Failure (Display still functional but bezel buttons are INOP)

EX5000 PFD – STec 55X

- **What lost?**
 - Ability to enter any autopilot commands
 - Ability to change which Garmin is driving NAV solution
- **Recommended Pilot Actions:**
 - Consider pulling the PFD CBs for less than 20 sec to warmstart the PFD
 - Do not pull the PFD CBs and keep them out for more than 20 sec – that is a drastic measure resulting in loss of entire PFD just to get GPSS, Alt hold and VS modes
 - Use the AP in the remaining usable modes
- **What you're left with:**
 - Alt Hold, NAV, GPSS, VS (at last VS bug value)

EX5000 PFD – DFC 90

- **What lost?**
 - Ability to enter some autopilot commands
 - Ability to change which Garmin is driving NAV solution
- **Recommended Pilot Actions:**
 - Consider pulling the PFD CBs for less than 20 sec to warmstart the PFD
 - Do not pull the PFD CBs and keep them out for more than 20 sec – that is a drastic measure resulting in loss of entire PFD just to get GPSS, Alt hold and VS modes
 - Use the AP in the remaining usable modes
- **What you're left with:**
 - Alt Hold, NAV, GPSS, VS, IAS, Envelope Protection
 - In other words, you're better off than in 55X system

AHRS Failure (Red-Xs over attitude and HSI compass card)

EX5000 PFD – STec 55X

- **What lost?**
 - Heading Hold/Capture
- **Recommended Pilot Actions:**
 - Leave display fully lit (don't dim the display) and use autopilot normally with the exception of HDG modes
- **What you're left with:**
 - All AP modes except HDG
 - Air data tapes on PFD

EX5000 PFD – DFC 90

- **What lost?**
 - All autopilot functionality
- **Recommended Pilot Actions:**
 - Immediately transition to hand-flying
 - Consider attempting a PFD warmstart (cycle power for less than 20 seconds via CBs)
 - Seek VMC as soon as feasible
- **What you're left with:**
 - No autopilot unless the PFD warmstart was successful

PFD Power Failure (Display and bezel buttons all blank/unlit)

EX5000 PFD – STec 55X

- **What lost?**
 - Heading hold/capture
 - Altitude capture
 - Ability to enter any autopilot commands except VS
- **Recommended Pilot Actions:**
 - Use ALT button to hold altitude
 - Verify the GPSS relay has been automatically thrown allowing Garmin 1 to drive GPSS mode on AP
 - Pull both PFD CBs if the relay was not automatically thrown
- **What you're left with:**
 - GPSS, ALT and VS via AP control head

EX5000 PFD – DFC 90

- **What lost?**
 - All autopilot functionality
- **Recommended Pilot Actions:**
 - Immediately transition to hand-flying and standby instruments
 - Consider attempting a PFD warmstart (cycle power for less than 20 seconds via CBs)
 - Seek VMC as soon as feasible
- **What you're left with:**
 - No autopilot unless the PFD warmstart was successful

Conclusions

- The DFC90 system is a much safer and capable system, even in reversionary or degraded conditions
 - PFD Display failures and Stec Turn Coordinator failures are the most common failure modes and the DFC90 has substantially more capability in those conditions than 55X
- There is approximately a 10x higher likelihood that the turn coordinator will fail, rendering the 55X inoperative than the AHRS failing, rendering the DFC90 inoperative